Quarterly Monitoring Report
Ground Water and Marine Water Analysis

For

NAVI MUMBAI INTERNATIONAL AIRPORT (NMIA)

Sponsor:

City and Industrial Development Corporation of Maharashtra Ltd (CIDCO)

Period:

October – December 2018

PREPARED BY

ADITYA ENVIRONMENTAL SERVICES PVT.LTD.
MOEFCC Recognized Laboratory under EP Act 1986
Accredited under ISO 9001: 2008 & OHSAS 18001: 2007 by ICQS
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1. INTRODUCTION

Mumbai Metropolitan Region (MMR) comprises of areas in and around Mumbai city and includes parts of Mumbai, Thane and Raigad Districts. Mumbai is known as the commercial capital of India and MMR is an industrial and technologically advanced region, which has experienced rapid growth in income and employment. The increasing trend in trading, business and financial services, demands highest order of infrastructure. There is need to enhance the capacity of airport as the existing airport in Mumbai experiencing tremendous pressure for meeting the air traffic demands of this vibrant region. Realizing the need of second airport for Mumbai, the Government of Maharashtra granted approval and appointed City & industrial Development Corporation of Maharashtra Limited (CIDCO) as Nodal agency for implementation.

The site for the airport was selected near Panvel in Raigad district of Maharashtra state with central coordinates 18°59'33.00"N and 73°4'18.00"E. The Director General of Civil Aviation (DGCA) has approved the site. Environmental Impact Assessment (EIA) study was conducted by Centre for Environmental Science and Engineering (CESE), Indian Institute of Technology (IIT) Mumbai and updated report submitted in April 2011. Environmental Clearance was granted by Ministry of Environment and Forests vide F. No. 10-53/2009- IA.III dt 22.11.2010 and validity extended vide letter dt 20.12.2017.

Pre-development works for the site has started and as compliance to the Environmental clearance, CIDCO appointed Aditya Environmental Services Pvt. Ltd. (AESPL) to conduct Compliance Environmental Monitoring for the New Mumbai International Airport (NMIA) vide Tender No. C. A. No. 01 / CIDCO/ T&C/ CGM (T&A) / STE (S& A) / 2017-18 (2nd call – 1st Extension) & its Work Order No. CIDCO / T&C / CGM (T & A)/ STE (S-I& A)/2018/1383 dated 07.06.2018.

The sampling locations fixed by CIDCO for compliance monitoring once in each season (Post, pre & during monsoon) for ground water and marine/Surface water quality as per Tender are as given in Chapter II for month from October – December 2018. The assignment comprises monitoring of following parameters in and around the surrounding project area:

- Ground/Surface water
- Marine water for biological and physicochemical parameters.

2. SCOPE OF MONITORING WORK

2.1 Scope of Monitoring Work as per CIDCO Tender:

Scope of monitoring work as per CIDCO tender are as given below:

Table 2-1: Scope of Environmental Monitoring Work as per CIDCO Tender

Sr. No.	Parameters – as per Annexure B	Location	Frequency	Samples/ Year	Samples/ 2 years
1.	**Ground Water Quality (35):** **Physical Parameters -** pH, Temperature, Turbidity, EC, Salinity, TSS, TDS. **Chemical Parameters:** DO, BOD, COD, Magnesium, Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, Phenol, Total Phosphorous, Total Nitrogen, Sodium Absorption Ratio (SAR), Nitrite-N, Nitrate-N, Calcium. **Heavy Metals:** Fe, Zn, Mg, Mn, Cd, Cr, Hg. **Bacteriological Parameters**; Coliform Count. Total Heterotrophic Bacteria. SPC/100ML.	10	10 Stations per season (Post, Pre-& During Monsoon)	30	60
2.	**Marine/Surface Water Quality parameters (35):** **Physico Chemical parameters:** PH, Temperature, Turbidity, EC, Salinity (ppt), TSS, TDS. **Chemical Parameters:** Nitrate-N, Nitrite N, Phosphate-P, Silicate, DO, BOD, COD, O&G, Magnesium, Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, Phenol, Total phosphorus, Total Nitrogen. **Heavy Metals:** Fe, Zn, Mg, Mn, Cd, Cr, Hg **Bacteriological parameters:** Coliform Count. Marine Biology: Phytoplankton & Zooplankton	13	13 stations per season (Post, Pre-& During Monsoon)	39	78

2.2 Locations of Monitoring:

Sampling Locations have been specified by CIDCO in its Tender. The monitoring was carried out at the same locations as fixed by CIDCO. Details of monitoring stations for Ground Water, Marine Water- physicochemical & biological and along with location maps showing station locations are as given below:

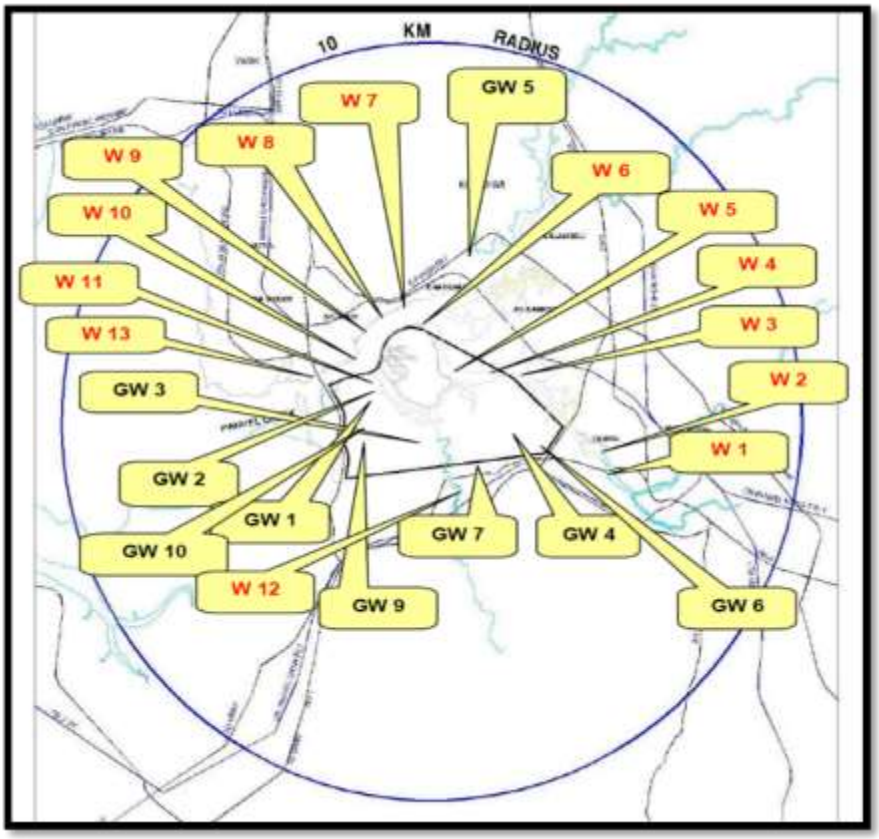
Table 2-2: Details of Ground Water Quality Monitoring Stations as per CIDCO Tender

Station Code	Stations Name
GW1	Open well at Kombadbhuje
GW2	A well near pond at Ganeshpuri
GW3	Open well at Vaghivalivada
GW4	Open well at Koli
GW5	Open well at Kopar
GW6	Open well at Chinchpada
GW7	A well near pond at Pargaon
GW8	A well near pond at Vaghivali
GW9	Open well at Ulwe
GW10	A well near pond at Targhar

Table 2-3: Details of Marine Water Quality Monitoring Stations as per CIDCO Tender

Station Code	Station details / Location
W1	Extreme end of Gadhi River (upstream side)
W2	Near Pargaon village (200m from W1) in Gadhi River
W3	Near Jui Village (300m from W2) in Gadhi River
W4	Near Kopar Khadi (300m from W3) in Gadhi River
W5	Near Vaghivali village (500m from W4) in Gadhi River
W6	Vaghivali creek junction (300m from W5) in Gadhi River
W7	Near Kharghar Rly Station (300m) in Gadhi River
W8	Near Belpada (300m from W7) in Gadhi River
W9	Near Konkan Bhavan (300m from W8) in Gadhi River
W10	Near Divala village (300m from W10) in Gadhi River
W11	At Junction of Ulwe and Gadhi Rivers in Panvel Creek
W12	In Ulwe River
W13	Near Rathi bander in Panvel Creek

Figure 2.1: Map of Surface Marine, Ground Water & Sediment Monitoring Stations as per CIDCO Tender



2.3 Period/Time of Sampling (October – December 2018):

The sampling survey was carried out as per following schedule during October – December 2018. Ground Water and Marine Water samples collected for Post monsoon season (December 2018).

Table 2-3: Period/Time of Sampling for this Survey

Month	Parameter	Sampling Stations	Dates of Sampling	Time Period
December 2018	GW	GW1, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9, GW10	14.12.18	Grab Sample
	Marine Water	W1, W2, W3, W4, W5, W6	7.12.18	Grab Sample
		W7, W8, W9, W10, W11, W12, W13	30.03.19	

3. METHODOLOGY ADOPTED FOR ENVIRONMENTAL MONITORING

3.1 GROUND WATER SAMPLING

3.1.1 Reconnaissance Survey:

The villages in study area use ground water from open/bore well and use it for drinking and other domestic purposes. Ground water gets contaminated due to bad sanitary habits such as washing of utensils, cattle and bathing and location of septic tanks in/near the open wells.

3.1.2 Methodology of Sampling:

Ground water sample is collected by using containers and the sampling container is rinsed before using it for storing water samples. Ground water samples are stored in two separate containers for Physicochemical & Microbiological analysis and preservatives added as recommended by Standard Methods APHA, stored in cold storage box and transferred to the laboratory for the further analysis.

Ground Water Sampling in Progress

3.2 MARINE WATER, SEDIMENTS & PLANKTON SAMPLING EQUIPMENTS

3.2.1 Reconnaissance Survey:

The study area represents complex hydrodynamic system. The Ulwe river flows down through the mountains (to the south) in the centre of project site and joins the Panvel creek. The Gadhi river flows from the East to the West. The Ulwe river will be diverted/retrained as part of the project and the Gadhi river will be partly retrained towards the northern part of the site. The river Gadhi receives sewage from Panvel town and nearby areas. Both the rivers drain into the Panvel creek which drains into the Arabian sea to the west. The Panvel creek also received effluents from CETP at MIDC Taloja and sewage from NMMC STPs in Nerul.

3.2.2 Methodology of Sampling:

3.2.2.1 Niskin Bottle - Marine Water Sampler

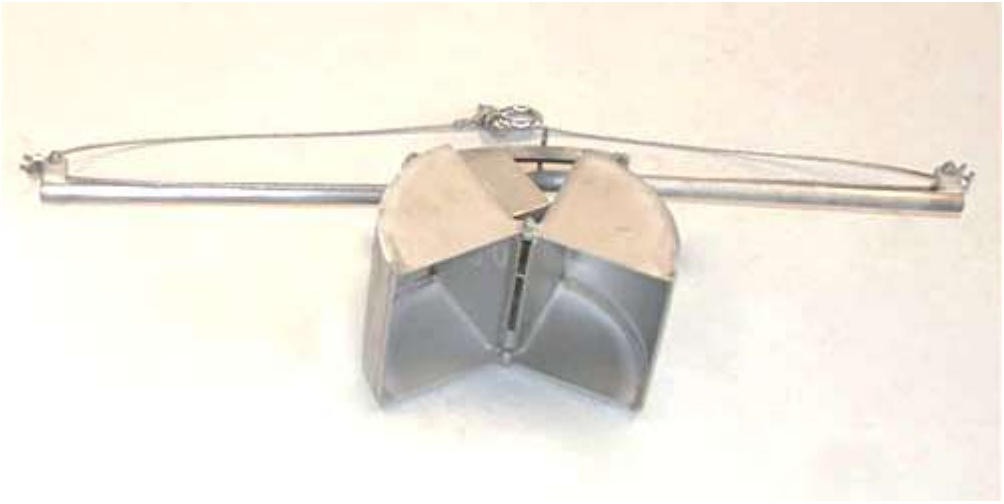
This Water Sampler is used to collect samples at various water depths and can operate at any depth on a cable or line with a messenger.

3.2.2.2 Plankton Net - Biological Samples

This plankton net operates a cable or lined by hand or behind a boat, it can be towed vertically or horizontally. Nets comes in varieties of size (Mesh no 00 equal an aperture of 0.30 inches)

3.2.2.3 Grab Sampler - For Marine Sediments

Sediment grab operate at any depth on a cable or line by free fall (without a messenger). It is extremely heavy and can take samples of hardest rocky ocean bottoms.



Grab Sampler

3.2.2.4 Selection of Stations, Preservation and Transportation of Samples:

Marine water samples were collected from sampling locations in Gadhi River, Ulwe River and Panvel Creek at the locations indicated by CIDCO – in all, 13 samples were collected from 13 sampling locations for physicochemical and Biological samples (Stations 1 to 10 are located in Gadhi River & Station 11 & 13 are Panvel Creek while station 12 in Ulwe River. A good amount of mangrove vegetation was noted on either side of stream 4 to 6. Sampling locations were approached by boats (wherever possible) and collection done irrespective of tide. Sampling were done only for surface water. The samples were preserved and taken to laboratory using vehicle on same day.

3.3 Laboratory Credentials

Sampling and analysis were done by laboratory of Aditya Environmental Services Pvt Ltd located at Plot P-1, MIDC Commercial plots, Mohopada, Tal Panvel, Dist. Raigad.

- Our Environmental Laboratory is recognized by Ministry of Environment & Forest (MoEFCC), Govt. of India under Environment (Protection) Act, 1986.
- Laboratory is also certified ISO 9001:2015 and OHSAS 18001:2007.
- Laboratory is accredited under ISO/IEC 17025:2005 (TC-7085) for water, wastewater and soil parameters
- Environmental sampling conducted by our experienced, qualified environmental staff & Analysis and reporting by approved Government Analyst.
- Instruments used for sampling are from reputed manufacturer & are regularly calibrated.

- Chemicals used are Analytical Reagent grade and from reputed manufacturer.

- Analytical Instrumentation used in the laboratory is regularly calibrated.

- We have regular program of Preventive & Annual Maintenance for all critical equipment.

- Ground Water, Soil Analysis - using APHA, BIS, ASTM & CPCB standards Methods for water Analysis.

- Standard Methods Adopted in the laboratory are those prescribed by APHA, BIS, ASTM & CPCB for water, waste & marine water analysis using methods as per NIO (National Institute of Oceanography) Manual.

- We have CRMs (Certified Reference Material) for heavy metals from reputed manufacturers for heavy metals and Standard sea water which we use for analysis.

- We are regularly participating in Proficiency testing with reputed Organizations like Central Pollution Control Board (CPCB), Goa State Pollution Control Board and others as also Intra laboratory QC testing to check performance of our chemists.

- Overall approach & methodology is with Annexure IA Scope of the work & the Best practices as per prevailing norms of Central Pollution Board /Ministry of Environment & Forest etc. /Internationally adopted practices.

4. COMPILATION OF DATA & INFERENCE

4.1 GROUND WATER QUALITY ANALYSIS REPORT

4.4.1 GW Analysis Data

The physicochemical analysis of ground water study showed considerable variation and is compiled and presented below:

Table 4-1: Ground water analysis at various stations during December 2018

Sr. No.	Sampling Locations	GW 1	GW 2	GW 3	GW 4	GW 5	GW 6	GW 7	GW 8	GW 9	GW 10
	Sampling month	14.12.2018									
1	pH	7.28	7.47	7.34	7.16	7.22	7.28	7.31	7.43	7.63	7.08
2	Turbidity	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3	Temperature	27.2	26.7	27.0	26.6	27.0	26.6	27.1	27.0	26.9	27.1
4	Conductivity	184.1	208.95	250.2	168.3	246.1	260.3	236.8	218.3	210.4	184.3
5	Salinity	1.2	1.4	1.7	0.9	2.2	2.0	2.1	1.5	1.7	2
6	SS	18	16	32	10	22	16	18	16	12	12
7	Total Dissolved Solid	120	150	170	110	160	170	150	140	140	120
8	Dissolved Oxygen	6.3	6.5	6.5	6.2	6.2	6.5	6.3	6.4	6.1	6.4
9	BOD	10	8	18	10	8	18	14	12	10	10
10	COD	40	30	50	30	20	60	50	30	40	30
11	Magnesium (as Mg)	2.88	4.32	11	6.24	10.4	6.7	5.76	6.24	5.76	7.68
12	Hardness (as CaCO3)	60	66	132	80	118	100	106	72	82	84
13	Alkalinity	88	62	90	60	76	78	74	52	76	76
14	Chlorides (as Cl)	42	50	78	45	70	82	80	58	57	54
15	Sulphate (as SO4-2)	12	22	18	16	36	40	30	38	40	40
16	Fluoride (as F)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
17	Sodium (as Na)	3	3	3	4	3	1	5	1	3	4
18	Potassium (as K)	4	5	8	7	6	5	9	6	9	7
19	Phenolic Compound	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Total phosphorous	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	TKN	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Sodium absorption ratio	0.3	0.8	0.6	1.07	0.6	0.24	1.1	0.28	0.78	1.1
23	Nitrate (as NO3-)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Nitrite (as NO-2)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Calcium (as Ca)	19.2	19.2	30.4	21.6	36.8	28.8	32.8	20.0	23.2	20.8
26	Iron (as Fe)	0.09	0.09	0.12	0.02	0.09	0.10	0.08	0.03	0.12	0.07
27	Zinc (as Zn)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Manganese (as Mn)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Cadmium (as Cd)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Chromium (as Cr)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Mercury (as Hg)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Coliform	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present
33	Heterophilic Bacteria (SPC/100 ml)	12.2×10^3	11.3×10^3	12.4×10^3	11.5×10^3	12.6×10^3	12.1×10^3	13.7×10^3	12.3×10^3	11.6×10^3	13.3×10^3

GW1: Open Well at Kombadbhuje; GW2: Well near pond at Ganeshpuri; GW3: Open well at Vaghivalivada; GW4: Open Well at Koli; GW5: Open well at Kopar; GW6: Open well at Chinchpada; GW7: A well Near Pargaon; GW8: Well near Vaghivali; GW9: Open well at Ulwe; GW10: Well near pond at Targhar

BDL: Below Detectable Limit

4.1.2 GW Analysis Inference:

The ground water quality showed considerable variation. Some ground water parameters were within desirable limit, some between desirable and permissible limit and few exceeded the permissible limit. The ground water not fully complied the quality requirements as per IS 10500 revised in 2012 for purpose of drinking water.

The quality of collected ground water was not suitable for drinking purpose due to the presence of coliform & heterotrophic bacteria at all locations i.e. Koli, Kopar, Pargaon, Chinchpada, Vaghivalivada, Ulwe, Ganeshpuri, Vaghivali, Targhar & Kombadbhuje.

Proper treatment of ground water required before consumption.

4.2 MARINE WATER QUALITY ANALYSIS REPORT

Surface Marine water samples were collected for different Physiochemical and Biological parameters from 13 stations 7th to 8th December 2018 (Post monsoon). Analysis part is mentioned in subsequent sections below.

Collection of water sample

Noting Down Air Temperature

Collection of phytoplankton sample Sample

Preservation of Phytoplanton

Collection of Zooplankton Sample

4.2.1 Analytical Data - Physicochemical Parameters during Post Monsoon

Table 4-2: Marine water physicochemical analysis at various stations during December 2018

Sr. No.	Parameter	W 1	W 2	W 3	W 4	W 5	W 6	W7	W 8	W9	W 10	W11	W12	W13	Unit
		S	S	S	S	S	S	S	S	S	S	S	S	S	
1.	pH	6.49	6.50	6.61	6.42	6.43	6.50	6.44	6.47	6.78	6.52	6.50	6.58	6.56	--
2.	Turbidity	4.6	2.0	5.2	6.2	2.5	2.0	6.1	2.4	1.3	2.8	3.6	4.2	2.8	NTU
3.	Temperature	21.7	24.8	26.8	27.2	23.1	32.7	34.9	34.6	34.0	31.4	32.6	20.8	33.1	°C
4.	Salinity	13.1	13.1	14.2	13.8	13.8	13.1	13.8	13.6	13.1	13.3	13.4	13.5	13.4	ppt
5.	TSS	128	112	138	154	128	112	118	124	92	118	126	138	134	mg/l
6.	TKN	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
7.	Total phosphorous	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
8.	DO	6.2	5.2	5.8	5.6	5.3	5.2	5.8	5.5	5.8	5.2	5.0	6.2	5.8	mg/l
9.	BOD	24	12	36	16	20	12	26	20	12	12	14	14	18	mg/l
10.	TDS	9820	9210	9860	9210	8920	9210	9460	8290	7980	8940	8940	9210	9810	mg/l
11.	Oil & Grease	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
12.	Nitrate as NO3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
13.	Nitrite as NO2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
14.	Sulphate as SO4	86.4	74.3	112.5	64	112.3	74.3	86.2	88	48.3	68.4	69.4	74.3	78.6	mg/l
15.	Iron as Fe	0.23	0.10	0.18	0.10	0.18	0.10	0.09	0.10	0.10	0.16	0.24	0.10	0.16	mg/l
16.	Magnesium as Mg	48.3	22.3	28.4	26.8	28.2	22.3	28.6	24	12.8	23.8	36.8	28.3	34.8	mg/l
17.	Chromium as Cr	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
18.	Cadmium as Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
19.	Mercury as Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
20.	Zinc as Zn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
21.	Manganese Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
22.	Sodium, Na	40	32	32	36	28	32	38	20	24	28	12	28	32	mg/l
23.	Potassium K	20	10	10	18	16	10	14	06	08	16	6	10	20	mg/l
24.	Silicate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
25.	Hardness	980	340	864	360	340	340	380	340	166	286	260	360	580	mg/l
26.	Alkalinity	420	356	352	356	224	356	254	352	182	240	214	356	420	mg/l
27.	Chloride	7840	7454	8023	7852	7462	7454	7860	7738	7454	7569	7638	7684	7624	mg/l
28.	Electrical Conductivity	1472	1805	1465	1375	1405	1805	6346	12373	11910	1805	1342	1386	1464	µS/Cm
29.	COD	90	42	120	60	40	42	90	70	40	60	60	60	60	mg/l
30.	Phenol	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l
31.	Fluoride	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	mg/l

4.2.2 Inference - Physicochemical Parameters during Post Monsoon:

The pH value ranged from 6.42 to 6.78 at surface basic nature of water. Salinity was low station W1, W2 and W12 due to influx of fresh water during collection Period of postmonsoon. The total suspended solids were found quite high.

Dissolved Oxygen level more than 5 mg/l is within normal limit suggest good amount of dissolved oxygen in the water body to support living organism. COD and BOD value suggests the presence of chemically and biologically oxidizable organic matter present in water body which comes as domestic sewage discharge from surrounding areas (villages, STPs of NMMC in Nerul) and effluents from CETP at MIDC Taloja.

The concentration of Manganese, Magnesium and Iron were low.

4.3 MARINE WATER QUALITY ANALYSIS REPORT (BIOLOGICAL PARAMETERS)

4.3.1 Inferences - Biological Parameters during Post Monsoon:

Table 4-3: Marine water biological analysis of stations (W1 to W7) in December 2018

Parameter	W 1	W 2	W3	W4	W5	W6	W7
	S	S	S	S	S	S	S
Phytoplankton							
Population (nox10³/L)	191.2	48.0	122.4	76.8	168.2	64.0	58.6
Total Genera	24	14	15	17	15	18	12
Major Genera	**Scenedesmus, Phacus, Pediastrum, Navicula**	**Leptocylindrus, Scenedesmus, Thalassiosira, Navicula**	**Thalassiosira, Skeletonema, Leptocylindrus, Navicula**	**Thalassiosira Coscinodiscus, Nitzschia, Navicula**	**Skeletonema, Thalassiosira, Cyclotella, Pleurosigma**	***Skeletonema, Thalassiosira, Leptocylindrus, Cyclotella***	***Thalassiosira, Navicula, Pleurosigma, Nitzschia***
Diversity Index	2.18	1.42	1.34	1.12	1.03	2.08	2.16
Zooplankton							
Population (nox 10³/100r	82.00	101.42	84.46	3.48	0.46	22.24	16.38
Total Group	4	3	3	3	4	4	5
Major Groups	Copepods Decapod Larvae	Copepods Decapod Larvae	Copepods Decapod Larvae	Copepods Gastropods	Gastropods, foraminiferans	Acetes Copepods	Acetes Copepods
Biomass (ml/100m³)	20.00	7.56	4.42	4.16	1.56	116.4	107.24
Diversity Index	0.54	0.54	0.68	0.21	0.57	0.82	0.62
Microbiology							
Coliform/100 ml	*P	*P	*P	*P	*P	*P	*P

Table 4-4: Marine water biological analysis of stations (W8 to W13) in December 2018

Parameter	W8	W9	W10	W11	W12	W13
	S	S	S	S	S	S
	Phytoplankton					
Population (nox10³/L)	82.6	32.6	72.6	136.4	48.0	52.6
Total Genera	17	14	15	16	18	20
Major Genera	***Thalassiosira, Skeletonema, Nitzschia, Cyclotella***	***Nitzschia, Skeletonema, Thalassiosira, Guinardia***	***Skeletonema, Cyclotella, Pleurosigma, Nitzschia***	***Leptocylindrus Skeletonema, Chaetoceros, Navicula***	***Thalassiosira, Skeletonema, Pleurosigma, Navicula***	***Chaetoceros, Thalassiosira, Skeletonema, Gyrosigma***
Diversity Index	2.24	2.06	2.36	2.12	1.48	2.22
Zooplankton						
Population (no x 10³/100m³)	41.42	26.22	36.02	20.6	8.42	22.16
Total Group	7	5	6	4	6	6
Major Groups	**Acetes Copepods**	**Acetes Copepods**	**Acetes Copepods**	**Acetes Copepods**	**Polychaete, lamellibranchs**	**Acetes Copepods**
Biomass (ml/100m³)	116.06	102.06	196.86	151.38	56.8	132.12
Diversity Index	0.64	0.76	1.32	0.26	0.78	1.14
Microbiology						
Coliform/100 ml	*P	*P	*P	*P	*P	*P

4.3.2 Inferences - Biological Parameters during Post Monsoon:

4.3.2.1 Phytoplankton

In December 2018, Phytoplankton population density ranges from 32.6-191.2 x 10^3/l at surface water of all 13 stations. Highest phytoplankton population at surface water of station 1 may be due to influx of domestic water from surrounding villages; total generic groups ranges from 12-24 nos. at surface water of all 13 stations. Maximum generic diversity 24 no. is observed at surface water of Station 1 during December 2018.

Thalassiosira, *Skeletonema, Pleurosigma and Navicula* are most common ones, followed by rest of observed genera like *Leptocylindrus*, *Cyclotella*, *Gyrosigma*. The other fresh water phytoplankton genera found are *Scenedesmus*, *Oscillatoria* in Gadhi River (Station W1, W2) and Ulwe River (W 12). *Nitzschia*, *Thalassiosira* and *Navicula* are common Genera noted in all stations. Graphical representations of phytoplankton population and total genera is represented in **Figure 4.5**.

The graph below represents the population of phytoplankton is more at station 1; and less at station 9, which represents there is discharge of sewage and domestic waste. The phytoplankton trend with respect to total number of genera is almost same throughout all stations. Some of the major genera seen were photographed and shown in **Figure 4.6**.

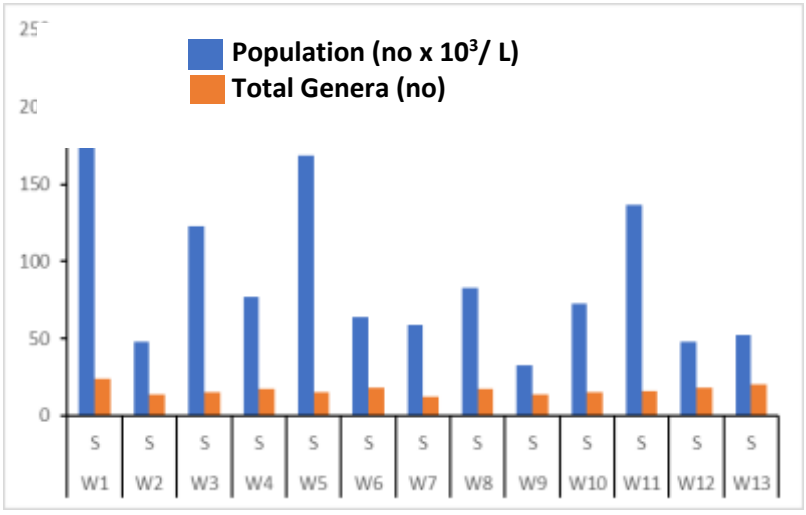


Figure 4.1 : Representation of phytoplankton population & Total genera for Dec 18

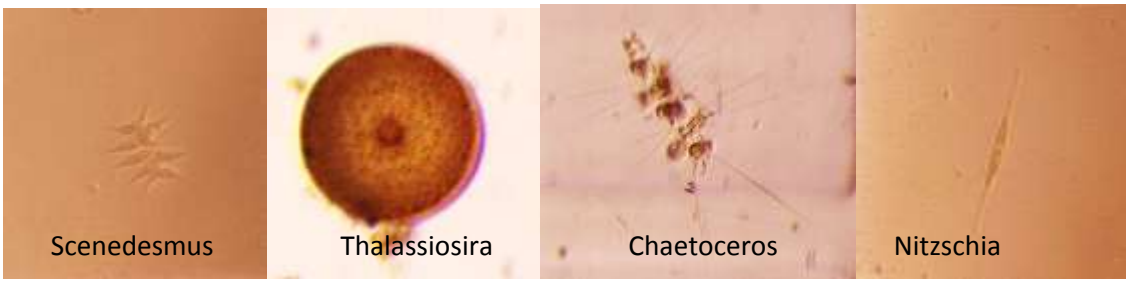


Figure 4.2: Phytoplankton found in samples for Dec 2018

4.3.2.2 Zooplankton

In December 2018, the zooplankton biomass ranged from 1.56 to 196.86 ml/100 m^3 with population density of 0.46 to 101.42 no x 10^3/100m^3 while having good faunal group ranging from 3-7 nos. The zooplankton was noted with good population and group diversity. Copepods, decapods, Acetes & polychaetes were common groups observed as, **Figure 4.7** represents zooplankton standing stock graphically.

The graph below represents that average standing stock reported from all stations; Station 5 shows lowest population and biomass as compared to Station 2, which shows; shows highest population and biomass respectively.

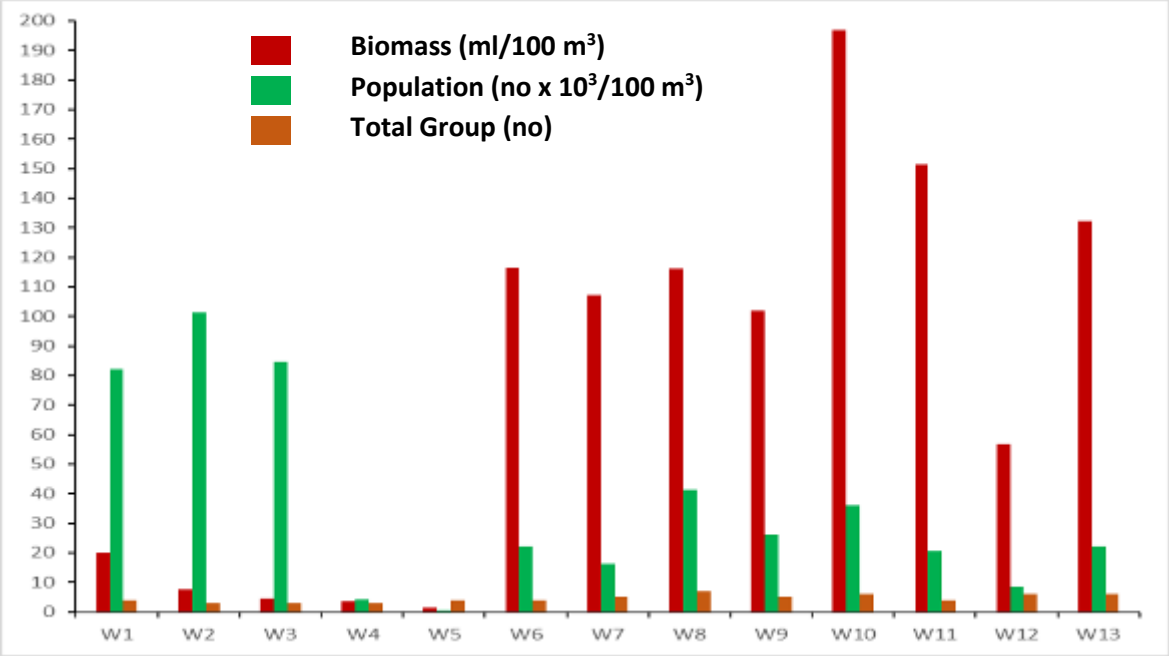


Figure 4.3: Representation of Zooplankton Biomass, Population & Total group Dec - 18

Figure 4.4: Zooplankton found in samples for December 2018

4.3.2.4 Microbiology

Coliform microbes were present at all stations in surface level. No specific trend was observed.

5. CHAPTER V: CONCLUSION & RECOMMENDATION

Based on the study of activities planned during pre-development works and on the basis of the environmental baseline monitoring results, certain issues are identified and steps taken to mitigate the environmental impacts. These mitigation measures need to be under constant watch through continuous vigilance, auditing and monitoring of air quality:

5.1 Ground Water:

5.1.1 Observations from Data:

Ground Water quality is poor and fails to meet IS 10500:2012 norms at number of locations. The area of the site is low lying and partially inundated during high tide. Ground water table is high and mostly open dug wells are seen in rural areas.

5.1.2 NMIA Pre - Development Activities and impacts anticipated on Ground Water Quality:

Construction activities at NMIA during pre-development works include:

- demolition of hill which will generate of material like murum and rock which will be utilized within site and balance will be taken to fill up nearby areas
- Site level is currently low and will be increased to +6 to +7m above existing GL by using excavated material.
- The area of the site is partially inundated during high tide. This area will be filled up to make available land for airport development

The ground water quality will get affected by above activities.

5.1.3 Further Study Suggested:

- As per clause (vii) under specific conditions of the Environmental clearance granted for the NMIA project by MOEFCC, "systematic and periodic monitoring mechanism need to be put in place by CIDCO to assess the impact on sub surface flow /impact on aquifers as well as surface water bodies in different seasons. Necessary additional environmental protection measures to be adopted to address the impact of proposed development in coastal sub surface flow as well as impact on aquifers".

The above study needs to be undertaken by a Functional Area Expert specializing in Hydrology/Geo- hydrology urgently in view of the fact that pre-development activities have started.

5.1.4 Mitigation Measures for Rehabilitated Settlements:

CIDCO needs to make adequate and clean piped water supply available for people to be accommodated in Rehabilitated settlements.

5.2 Marine Water:

5.2.1 Observations from Data:

Marine Water quality is moderate, may be due to hindrances.

5.2.2 NMIA Pre- Development Activities and impacts anticipated on Marine Water Quality:

Construction activities at NMIA during pre-development works include:

- demolition of hill which will generate of material like murum and rock which will be utilized within site and balance will be taken to fill up nearby areas.
- Site level is currently low and will be increased to +6 to +7m above existing GL by using excavated material.
- The area of the site is partially inundated during high tide. This area will be filled up to make available land for airport development

The marine water quality may get affected by activities such as land filling, diversion of courses of Ulwe and training of Gadhi rivers.

5.2.3 Further Study Suggested:

The re-coursing of Ulwe river and training of Gadhi river with provision of special channel to the North of the site in the proposed Master plan needs detailed studies so far as its impacts on marine water quality and drainage on the entire area is considered. The Environmental clearance has several clauses pertaining to this as below:

(1) The proposed re-coursing of tidally influenced water body outlets from Ulwe river has a large cross-sectional area at the middle with the river/creek on either end remaining unchanged with its natural course. The whole system should function as it was functioning earlier without airport project. Surface runoff should not be let into the channel just because the area of cross section is large. The whole airport area will be reclaimed, and the level raised to 7m whereas the existing level all around the airport will continue to be low in its natural state. There will be flow all around due to surface runoff. This additional quantity must be collected by appropriate drainage system and let into Gadhi River and not into the recoursing channel. The recourse channel may be able to take it but not the river or creek on either side of the channel. This aspect shall be examined by CIDCO in details to avoid the flooding of the low-lying areas besides inducting other hydrological and environmental studies.

(2) The entire system shall be studied as one composite system with appropriate boundary conditions to reflect the worst conditions – minimum 100 years to be specified and compliance ensured such as -flooding, surface runoff not only from the airport but also from surrounding areas as well, normal flow, tidal flow due to tidal surge having a long return period, possible obstructions to flow, tributaries joining the main river etc. so as to take appropriate protection and remedial measures. Due to construction of recourse Channels and also due to tail end of the Gadhi & Ulwe Rivers into Panvel Creek, there is a need to prepare a Comprehensive Master Plan for

Surface drainage and Flood protection, keeping in view the proposed developments. CIDCO shall submit the above Master Plan to the Ministry.

(3) On the northern part of the airport there is a secondary channel of the Gadhi River which will be filled up for the airport runway construction. This will be replaced by a shorter channel along the northern boundary of the airport. The channel shall be designed appropriately through overall modeling study so that the channel provides tidal water to the mangrove park and moderate tidal flows under worst environmental conditions. Need for widening and deepening of Gadhi River may also be studied simultaneously, if required. The revised widths and depths of recourse channels shall be determined with modified drainage and worst rainfall/tide conditions including appropriate factor of safety.

The above studies need to be undertaken on priority in view of the fact that pre-development activities have started.

5.2.4 Mitigation Measures for protection of Marine Water Quality:

Mitigation measures taken up at NMIA during pre-development works are as follows:

- landfilling is done in areas inundated during high tide, taking care that there is no disposal of debris in inter tidal area, nor any water way is obstructed
- for excavated areas and freshly filled up areas, proper garland drains leading to settlement basins followed by filter bunds are provided so that rainwater does not carryover the loose excavated material into marine areas.
- polyelectrolytes are used to help settle loose suspended material in the settlement basins.